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DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
STANDARD

PERT Procedures for Contractor or Grantee Use

(Program Evaluation and Review Technique)

FOREWORD

This standard is intended to provide uniform guidance to FAA contractors or grantees (excluding grantees of Federal Assistance to Airports Programs and Airport Development Aid Programs) concerning the format and content of PERT charts submitted with Progress Reports on contracts or grants with FAA, requesting PERT charts. It is intended to familiarize the contractor or grantee in a general way, with the technique and how it is applied.

CHAPTER 1. SCOPE

1.1 Scope. This standard establishes the requirements of FAA for PERT time charts submitted by contractors or grantees pursuant to FAA Order 1700.8, "Format for Scientific and Technical Reports," dated 1/5/70.

CHAPTER 2. PURPOSE

2.1 Purpose. The purpose of this standard is to prescribe a uniform format and content to the degree practicable, for PERT charts, submitted with Progress Reports by FAA contractors or grantees where such PERT charts are required by the contract or grant.

CHAPTER 3. DEFINITIONS

3.1 Glossary. The following principal terms are defined in the Glossary - Appendix 1:

- Activity
- Constraint
- Critical Path
- Directed Date for an Event (T_D)
- Earliest Expected Date (T_E)
- Event
- Expected Elapsed Time (t_e)
- Interface Event
- Milestones
- Network
- Slack
- Latest Allowable Time (T_L)

CHAPTER 4. BIBLIOGRAPHY

4.1 Reference Documentation. The following reference documentation is provided for general guidance only and is not controlling when in conflict with the contents of this standard:

a. USAF PERT-Time System Description Manual, Vol. I, September 1963, available from PERT Orientation & Training Center, 1111 20th St., N.W., Washington, D.C. 20333 by citing applicable RFP and issuing Agency.

b. PERT Guide for Management Use, June 1963, PERT Coordinating Group, for sale by Superintendent of Documents, Government Printing Office, Washington, D.C.

c. NASA-PERT Handbook, NASA, Washington, D. C.

d. Martino, R.L., Project Management & Control, Vols. 1 & 2. American Management Association, New York

CHAPTER 5. PERT TIME TECHNIQUE

5.1 Objectives. PERT technique and charts are expected to provide contractors or grantees and FAA representatives with a means for accomplishing the following objectives:

a. The identification of the sequence in which jobs are to be accomplished.

b. The identification of time allowable and estimates of time required for the completion of jobs.

c. The graphic portrayal of a plan by which work effort can be related directly to goals and objectives.

d. The portrayal of interdependencies, interrelationships and priorities among jobs to be accomplished.

e. The identification of the critical path and slack areas in order to permit timely corrective action by management.

f. The provision of data for judging probability of meeting schedules.

g. The provision of a common system for the communication of plans and reporting of progress against those plans.

5.2 PERT - What It Is. PERT stands for Program Evaluation and Review Technique. PERT is a management tool for planning, scheduling and monitoring the job to be done. It graphically portrays activities and events which must be accomplished in sequential order, to achieve a planned goal.

5.3 PERT Implementation Steps. The following steps in sequence are typical in PERT implementation:

- Collect and analyze planning data.
- Identify contract end items.
- List and select major Events.
- Title, describe and number Events.
- Develop Network - sequencing and interrelating Events.
- Draw Activity arrows between Events.
- Develop time estimates for Activities and Events.
- Calculate the expected and latest allowable times for the events and identify Critical Path on Network.
- Develop procedure for manual or computer processing of data.
- Develop procedure for Progress Status Information System.
- Provide rapid analysis of Progress Reports.
- Evaluate alternative courses of action.
- Recycle.

5.4 Content and Format of PERT Charts

a. Network

The Network portrays graphically (work flow diagram) each major activity and Event which must be accomplished in order to achieve the contract goal. Each activity and Event is portrayed in relationship to all other major activities and Events in the plan. The network shows the sequence in which the activities and events must be accomplished, the degree of their independence and the extent to which they can be performed in parallel.

b. Drawing the Network.

- Generally, for graphic presentation purposes, where appropriate, events should be positioned on the chart relative to a time scale in the interest of clarity. An event occurring before another event would normally be positioned to the left of the succeeding event. Care should be exercised to prevent bias in activity estimates and distortion of network logic by use of such time scaling. Such bias and distortion may be avoided by time scaling after the network is completed and calculated.

- The development of the network represents the detailed planning for accomplishing the contract objectives.

- Usually the objective is the end event of the network. Experience indicates that the most effective method of constructing networks is to record the final event and proceed back through all the contributing events which must be accomplished to achieve the final event.

- The advantage of starting with the end objective is that the network is more likely to contain only those events which must be achieved rather than those that are possible.

- The network should then be critically examined to insure that all interrelationships and interdependencies between all events are determined.

- All interdependencies of the program must be shown.

- Only one activity line may connect any pair of events.

c. Event Identification

- PERT networks may be event or activity oriented as appropriate or required in the contract. Events may be portrayed by circles or other geometric figures suitable for readability and clarity.

- The event distribution must represent a clearly definable chart of occurrences in order to give the same understanding to all network users. Activities should be clearly definable for assignment of singular responsibility. The event title should be written briefly within the geometrical figure depicting the event.

- Network Event Numbers

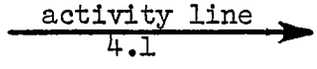
  Event numbering should be at the discretion of the program office or service and should be based on a logical pattern.

d. Time Estimating

The next step after completing the network, is to estimate the time for accomplishing each activity. These time estimates should be made by the people most familiar with the activity.

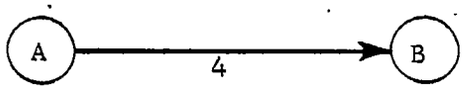
Each activity should be considered separately in making time estimates. The estimates should be in weeks and tenths of weeks needed to complete the activity. Each time estimate should be the best available, based on all known factors of how long it will take to complete the activity under normal conditions.

Time may be portrayed above the event symbol in terms of calendar date, generally thus 1/1/70, 7/30/70. The elapsed time estimate generally should be shown below the activity line, i.e.,



Expected Elapsed Time (t_e)

The expected elapsed time is the time which an activity is predicted to require for completion.



Earliest Expected Date (T_E)

After determining the expected elapsed time for each activity, these times are added from start to completion of the various network paths. In this way the earliest expected time for each event in the paths and total elapsed time is determined. The earliest expected date for contract completion is identified by the T_E for the final event of the network. When more than one path leads to an event, the longest of these paths established the T_E for that event.

Latest Allowable Dates (T_L) are then determined for each event in the network starting with a predetermined date for the final event and subtracting the elapsed time estimates, moving backward through the various network paths. The T_L (latest allowable date) for the first event of the network will then indicate the latest date by which the program can be started without causing the end event to slip beyond the predetermined date.

Determining Slack Time

Slack time is determined by subtracting T_E from T_L for any event. Such a computation will result in positive slack time, zero slack time, or negative slack time.

The critical path has major significance in that it is the path (sequence of activities) which must have additional resources or require replanning, i.e., money, manpower, facilities, applied to it, if it is desired to reduce the time needed for completion.

For example, if a subprogram network has three paths of 10, 8 and 7 weeks duration, and it is desired to shorten the time required to complete the subprogram, it will serve no useful purpose to provide the paths having 8 or 7 weeks with additional resources since the critical path, which is 10 weeks, determines the length of time required to accomplish the subprogram.

e. Scheduling

In the development of a network plan it will not, generally, provide a schedule for the work to be done. This is true because the time estimates, made irrespective of calendar dates and based on normal working conditions, do not take into account the availability of resources during the specific calendar periods. The network, therefore, must be translated into a timetable with specific calendar dates, which will govern the start and completion of work and authorize expenditure of resources. This translation process will be controlled by the availability of resources and the manager's judgment.

f. Art Size

Generally standard size for chart will be 21" x 16" which will be photographically reduced to 10½" x 8". Where this is not practicable, foldouts or multiple charts may be submitted.

g. Text Size and Content generally should be at the discretion of the program office or service but the following is offered as a guide:

- When a 21" x 16" or larger chart is used, event symbols will be 1½" or larger as appropriate for readability.
- When a 10½" x 8" chart is used, event symbols will be 1".

- Narrative typing is to be all caps on the 21" x 16" chart and upper and lower case on the small chart. On larger charts, using type setting, point size should be appropriate for readability.

- Descriptive words within event symbols are to be abbreviated to the degree practicable. For guidance concerning contractions and abbreviations see: American National Standards Institute, Inc. "Symbols for Units Used in Electrical Science and Electrical Engineering," No. Y 10.19-1967; "Abbreviations in Vol. I. USAF 'PERT' September 1963;" and "Style Manual," U.S. Government Printing Office, January 1967. The description is to occupy the center of the event symbol. Serial numbers identifying events are to be positioned at bottom of the symbol. Responsible organization code, where practicable, shall be positioned at top of and within the event symbol. Activity estimate in weeks will be centrally positioned below the activity arrow.

- Directed or scheduled date of the event accomplishments is to be shown above the event symbol. Revised dates will be shown above the initial date with a line drawn through the original date.

h. Printing

Chart reduction, generally, should be at the discretion of the program service or office, but the following is offered as a guide:

- For purposes of reproduction, the PERT chart should be reduced to $10\frac{1}{2}$" x 8".

APPENDIX 1

Glossary

Activity

A work effort of a program which is represented on a network by an arrow. An activity may also simply represent a connection or interdependency between two events in the network. An activity cannot be started until the event preceding it has occurred.

Constraint

The relationship of an event to a succeeding activity wherein an activity may not start until the event preceding it has occurred. The term "constraint" is also used to indicate the relationship of an activity to a succeeding event wherein an event cannot occur until all activities preceding it have been completed.

Critical Path

That particular sequence of events and activities in a path that has the greatest negative or least positive slack; therefore, the longest path through the network.

Directed Date for an Event (T_D)

Date for a specific accomplishment formally directed by the contracting authority. A schedule completion date (T_S) which has been formally specified by contracting authority.

Earliest Expected Date (T_E)

The earliest calendar date on which an event can be expected to occur. The T_E value for a given event is equal to the sum of the expected elapsed time (t_e) for the activities on the longest path from the beginning of the program to the given event. It is frequently transposed to a calendar date.

Event

A specific, definable accomplishment in a program plan, recognizable at a particular instant in time. Events do not consume time or resources.

Expected Elapsed Time (t_e)

The elapsed time which an activity is predicted to require. Generally, the expected elapsed time is identical to a single time estimate for the work to be accomplished.

APPENDIX 1

Interface Event

An event which signals the necessary transfer of responsibility, end items, or information from one part of the plan to another. Examples of interface events are the receipt of an item (hardware, drawing, specification) or the release of engineering drawings to manufacturing.

Milestone

Milestones are synonymous with events in a network.

Network

A flow diagram consisting of the activities and events which must be accomplished to reach the program objectives, showing their planned sequences of accomplishment, interdependencies, and interrelationships.

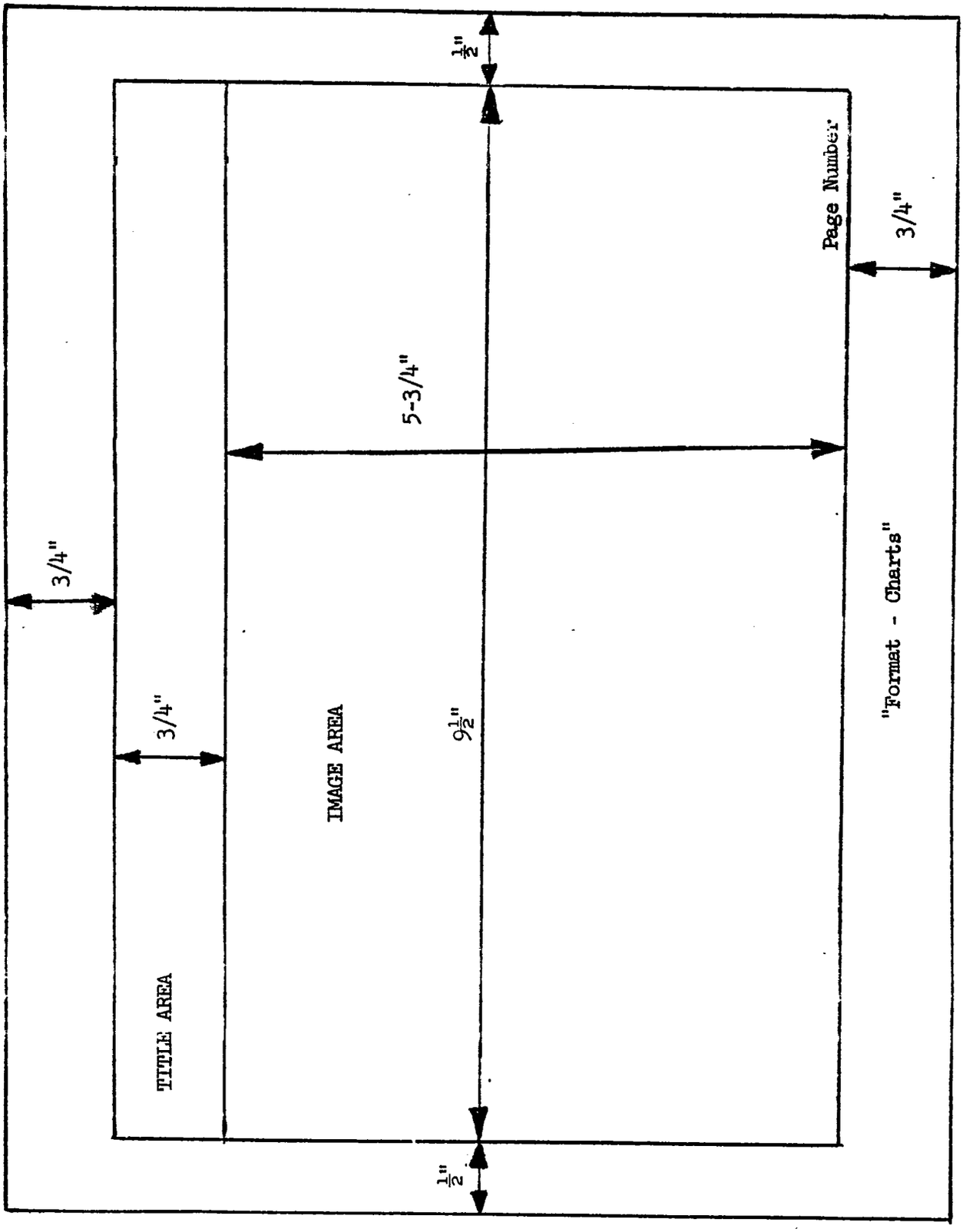
Slack

The difference between the latest allowable date and the expected date ($T_L - T_E$) or the difference between the latest completion date and earliest completion date ($S_L - S_E$). Slack is a characteristic, as such, of the network paths. Slack may be positive, zero, or negative.

T_L = Latest allowable time.

The latest calendar date on which an event can occur without delaying the completion of the program. The T_L value for a given event is calculated by subtracting the sum of the expected elapsed times (t_e) for the activities on the longest path between the given event and the end event of the program from the latest date allowable for completing the program. T_L for the end event is equal to the directed date (T_D) of the program. If a directed date is not specified, $T_L = T_E$ for the end event.

APPENDIX 2



SAMPLE - ART SIZE

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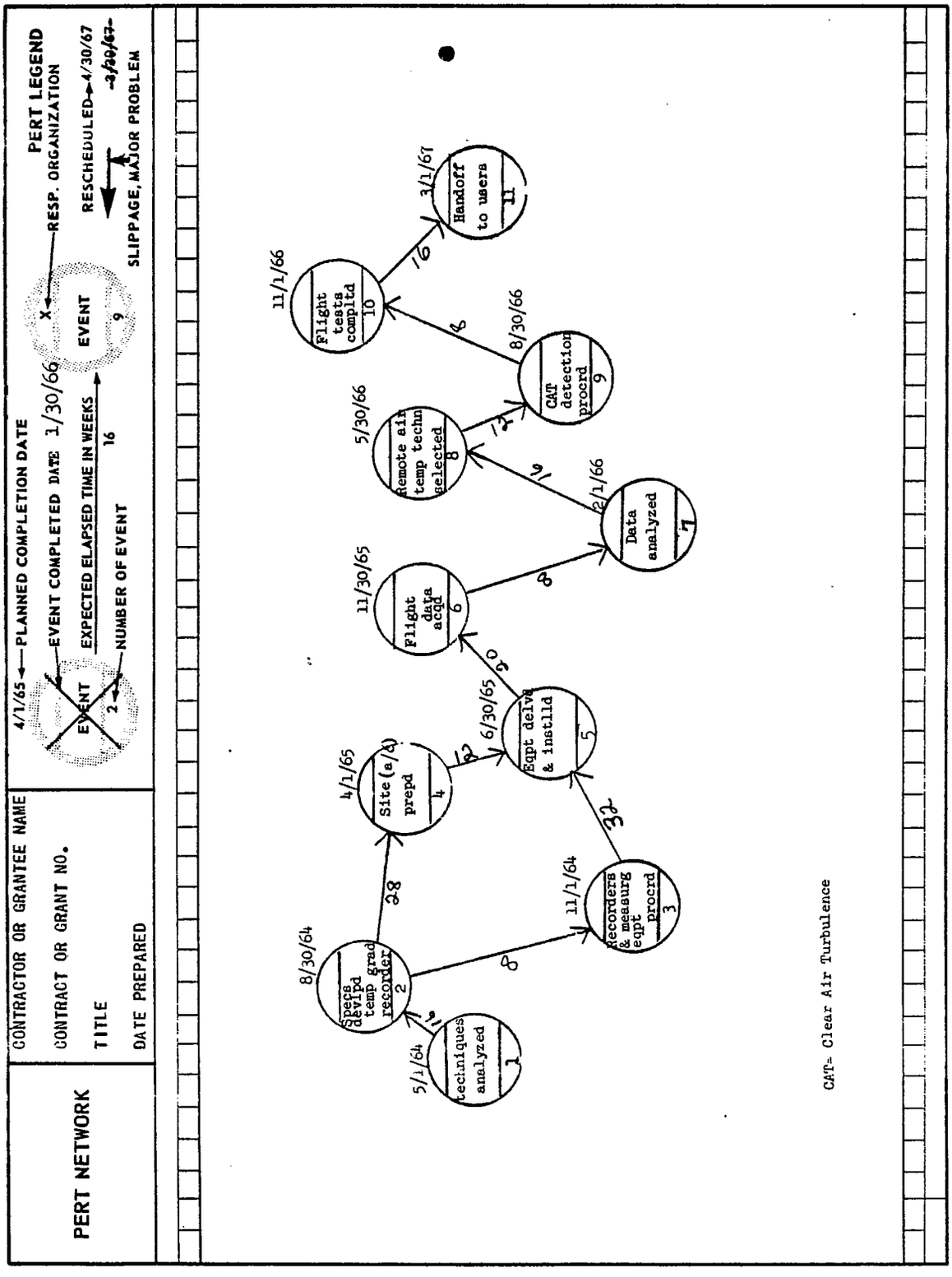
APPENDIX 3



SAMPLE - PERT TIME NETWORK

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